ARROW
USER GUIDE

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CONTENTS

INTRODUCTION

ARROW is a computer language. This means that it allows you to give instructions to the computer to do a certain job. As with all computer languages you have to give your instructions in a clear and precise way. The instructions that you can give are limited - you can't tell the computer to jump up and down, or to touch its toes.

The instructions, more usually refered to as commands, that you can use with ARROW are mainly to do with drawing on the screen or, if you have one, using a turtle to draw on the floor. The language is derived from LOGO, a more comprehensive language. ARROW is an attempt to present the possibilities for screen drawing in a straightforward way. It would be quite possible for users who become proficient with ARROW to progress to using LOGO.

As with LOGO, one of the most powerful features of ARROW is the ability to invent new commands from a combination of the existing commands, and then use these new commands in exactly the same way as the existing ones. It is possible to save these new commands on a cassette or a disc and use them again at a later date.

This booklet describes a version of ARROW designed to run on the following:

1. A cassette based Research Machines 480Z with at least 32K of memory and the High Resolution Graphics Option; you will also need BASIC in ROM.

2. A disc based Research Machines microcomputer system with High Resolution Graphics board and 56K of memory; you will need also BASICSG version 5.

The differences between cassette and disc use are given, where necessary, in the text.

HOW TO USE THIS BOOKLET

This booklet comes in five sections. Chapter 1 is a step by step introduction to most of the features of ARROW, telling you what to type and what you can expect to see. Anything you need to type has been underlined. The chapter also includes some exercises. Chapter 2 gives some ideas for further directions. The third chapter of the booklet goes through each of the commands in alphabetical order and explains their use in full. Chapter 4 is a set of technical notes and a more detailed explanation of some of the error messages. The final chapter gives possible solutions to the exercises in chapter 1.

If you are a beginner it is recommended that you work through the whole of chapter 1, trying the exercises as you go. Answers are given in chapter 5,

although you should understand that they are not the only solutions, or
even necessarily the best ones - they are there to help you if you've had
any problems.

CHAPTER 1

GETTING STARTED

LOADING THE PROGRAM - INTO A LINK 480Z CASSETTE SYSTEM

Begin by switching on the 480Z microcomputer; you should see an introductory message on the display screen. Start the BASIC by typing:

R

Put the tape which contains ARROW into the cassette recorder with side A uppermost, Make sure the tape is fully rewound then type:

LOAD "ARROW" [RETURN]

and press the PLAY button on the cassette recorder. The screen should then display each block of the program as it is read in, as follows:

ARROW	0000		
ARROW	0001	or	Loading ARROW 0000
ARROW	0002		
ARROW	0003		

The block numbers change as each section of the program is read in from the cassette tape. When the program has finished loading, you should see the message :

Ready:

LOADING THE PROGRAM - INTO A DISC BASED SYSTEM

Begin by switching on the microcomputer - you should see a message on the display screen. You will also need a disc with the operating system, CP/M, on it, the correct version of BASIC - BASICSG Version 5, and another disc with a copy of ARROW. Put the first disc in the top, or leftmost, drive and the other disc in the other drive (if your system has only one disc drive then you will need to change these discs after you have loaded BASIC - see below). Type B and then the following sequence (the messages may be slightly different) - the parts you type are underlined:

B
Research Machines
56K CP/M Version 2.2

A> BASICSG [RETURN]

There then follows a message from BASIC followed by

Ready:
LOAD "B:ARROW" [RETURN]

RUNNING THE PROGRAM

When you have successfully loaded the program, type:

RUN [RETURN]

A page of information about the program will then appear, together with an arrow in the middle of the screen. This is followed by a colon (:) at the bottom left hand corner of the screen. This is called the colon prompt. You can give any instruction that ARROW understands whenever you see the colon at the bottom left hand corner of the screen.

To start with you should try out the simple movement commands, which are FORWARD, BACKWARD, LEFT and RIGHT. Each command must be followed by a number, and don't forget to leave a space between the command and the number. For example, type :

FORWARD 40 [RETURN]

The screen will clear of everything except the arrow. A line will then be drawn in the direction of the arrow, 40 units long. As a rough guide, the screen is about 300 units wide and 200 units high. If you go off the edge of the screen the arrow is still there, but you won't be able to see it.

Now type :

LEFT 90 [RETURN]

This will turn the arrow by 90 degrees (a quarter turn) to the left. Now type in the following - but remember to always wait for the colon prompt before typing the next instruction. (You should always press the [RETURN] key at the end of each line but it won't be shown from now.)

FORWARD 30
RIGHT 45
BACKWARD 80
LEFT 45
FORWARD 20

You should end up with the following picture :
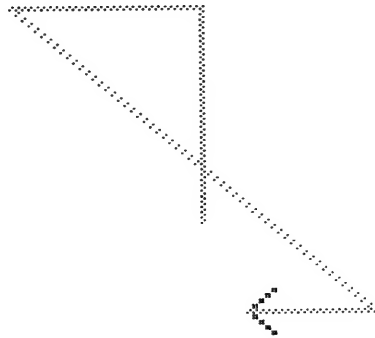
To get a clean screen and return the arrow to the centre at any time type :

FRESH

EXERCISES

1. See if you can give the instructions to make each of the following
    shapes. The starting position of the arrow is shown each time. It
    is a good idea to write down your attempts before you actually type
    them into the computer.
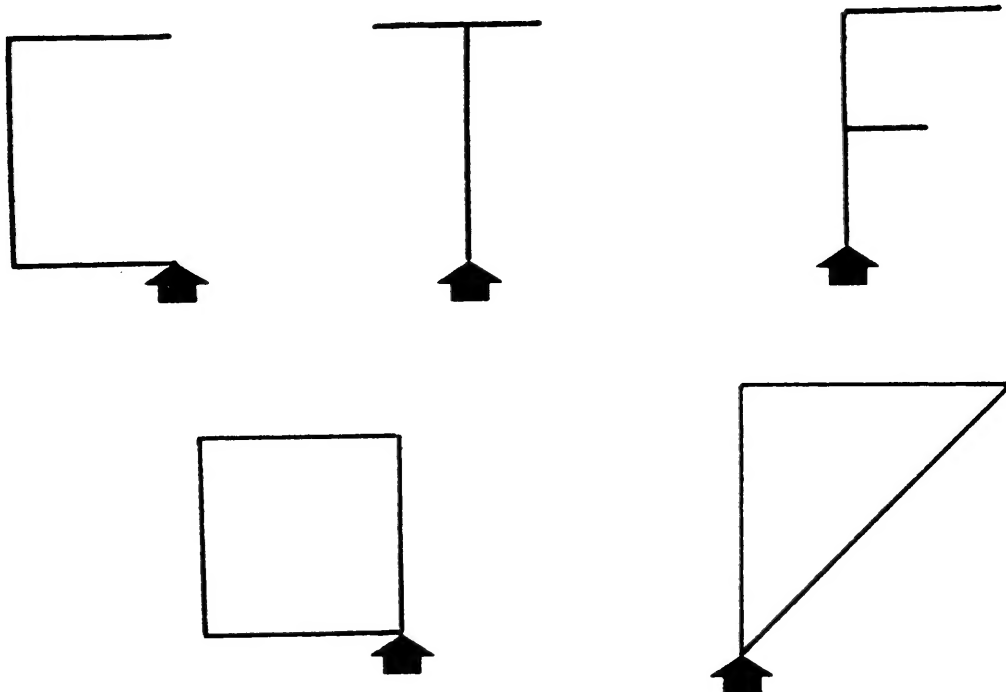
2. Give the instructions for drawing a triangle whose sides are all 50
    units long. You will find it helpful to draw a picture and measure
    all the angles.

3.   Design your own shape, such as a dog or a hat - draw it out
     carefully on paper before you start writing down the instructions.
     Don't make it too complicated - if it has much more than ten sides,
     or any curved sides you may find it difficult.

Moving Without Drawing

So far you have only been able to draw a shape which is entirely connnected
together. If you want to draw two separate shapes, then you need to lift
the pen off the paper and use the normal commands to get where you want to
go, but without leaving a trace. You then put the pen back on the paper to
carry on drawing.
Try the following :

     FRESH
     FORWARD 40
     RIGHT 90
     FORWARD 40
     RIGHT 90
     PEN OFF
     FORWARD 10
     PEN ON
     FORWARD 30
     RIGHT 90
     FORWARD 30

You should now end up with the following picture :

Repeating yourself

If you are drawing a square you will notice that you give the same two
instructions, 4 times. An easier way of doing this is to use the REPEAT
command. When you start the repeat you must say how many times you want to
repeat the instructions. You then type the instructions that you want to
repeat and when you have finished that list, you must then give the LIMIT
instruction.

Now try the following:

    <u>FRESH</u>
    <u>REPEAT 4</u>
    <u>FORWARD 50</u>
    <u>LEFT 90</u>
    <u>LIMIT</u>

You will notice that when you give the REPEAT instruction, it allows you to type your instructions to a slightly different way, and nothing happens until you give the LIMIT instruction. The computer then obeys the instructions in order, and shows you what it is doing at every stage.

You should end up with the following picture:
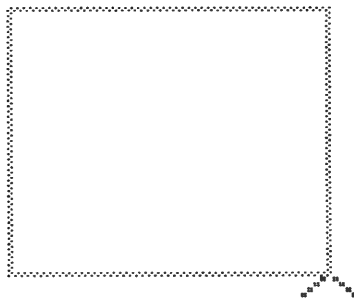
EXERCISES

4. Use the REPEAT instruction to draw a triangle where every side is 50 units long. You may have to experiment with the angle to decide how far to turn each time.

5. Use the REPEAT instruction to draw a rectangle which is 40 units high and 70 units long.

6. Choose one of the shapes that you drew in question 1, and use the Repeat instruction to draw five of them in a row. Remember to switch the pen off before moving to the start of the next shape.

Building you own instructions

So far, everything that you have done has produced a picture on the screen but as soon as you give the FRESH instruction your picture goes and the only way to get it back is to type in all the instructions again. However, there is a command that asks the computer to remember a set of instructions, and you can then use them as many times as you like, just like the other instructions which are there already. To ask the computer to remember a set of instructions you must give them a name, and it is sensible to call them something which reminds you what the instructions will do.

7

For example, we will ask the computer to remember the instructions to draw a square, and we will call them SQUARE. This is how to do it:

    BUILD SQUARE
    REPEAT 4
    FORWARD 50
    LEFT 90
    LIMIT

You will notice that after the BUILD instruction the screen changes to be the same as when you gave a REPEAT instruction. However, this time when you type LIMIT, the computer is still waiting in case you want to give some more instructions. To tell it that you have finished you must press the

ESC key (which is usually at the top left hand corner of the keyboard)

    Press the ESC key

Even then the computer will not actually draw the square until you give the SQUARE instruction. Now type the following:

    FRESH
    SQUARE
    PEN OFF
    RIGHT 45
    FORWARD 20
    LEFT 45
    PEN ON
    SQUARE

You should now end up with the following picture:
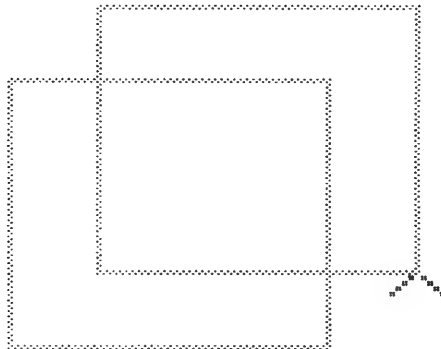
A set of instructions which you build like this is called a procedure.

7. Use the BUILD instruction to store the instructions for the triangle that you drew in question 4. It will be helpful later if you call this TRIANGLE, and if it uses LEFT turns.

8. Use the BUILD instruction to store the instructions for drawing one of the shapes from question 1.

9. Use the BUILD instruction to store the instructions for drawing a row of five of the shape that you have just chosen for question 8. You are allowed to use the procedure that you built in question 8 inside your new procedure, instead of typing it in again.

Changing things

It is possible to use your square and triangle together, to make a house. (This assumes that you answered question 7, and that you called you procedure TRIANGLE.)

Now try typing the following:

BUILD HOUSE
SQUARE
TRIANGLE
Press the [ESC] key

If you now type

FRESH
HOUSE

you should end up with the following:
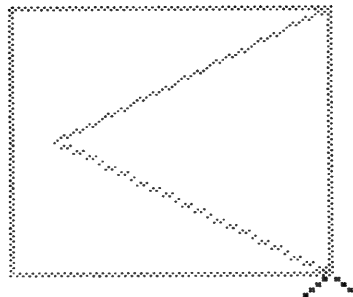
(your answer may be different, if you drew your triangle with LEFT instead of RIGHT turns.) Anyway, this hasn't drawn a house - it looks more like an envelope. You will need to change HOUSE, so that it draws the triangle at the top.

Now type the following:

CHANGE HOUSE

This puts your version of HOUSE on the screen, and lets you alter it. The screen should look like this:

HOUSE

    SQUARE
    TRIANGLE
    END

Press U to move up, D to move down
    E to end, R to remove a line
    S to alter stores used WITH procedure
    I to start inserting

You need to put in two extra lines between the SQUARE instruction and the TRIANGLE instruction. To do this you need to move the flashing mark to that position and then start inserting:

    D to move down
    I to start inserting
    FORWARD 50
    LEFT 30
    press | ESC | to stop inserting
    E to end the changes

If you now type

    FRESH
    HOUSE

you should end up with the following:
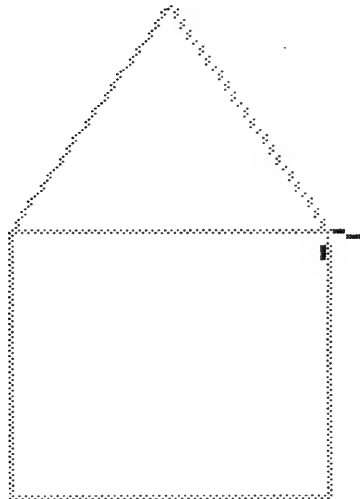
Procedures that use numbers

So far, your procedures will always do exactly the same every time that you use them. However, we may want to make something a different size, or to have different number of sides, for example. You can do this by making your procedure behave in the same way as normal instructions. For example, you can build a curve so that it is whatever length you want, by typing the following:

BUILD CURVE WITH LENGTH, NUMBER
REPEAT NUMBER
FORWARD LENGTH
RIGHT 3
LIMIT
Press [ESC]   to stop building

The WITH LENGTH, NUMBER part of the BUILD command means that whenever the instruction CURVE is used, two numbers will be expected. The first will be the length of each bit of the curve, and the second will be the number of these bits that make up the curve. We could have used any names for these two number, but it is sensible to use ones that remind you what they are. These are called stores, because they are each used to store a number until we want to use it again. Note that they only have an effect if you use them in the right way inside what you build.

If you now type

     <u>FRESH</u>
     <u>CURVE 4,25</u>
     <u>RIGHT 105</u>
     <u>CURVE 4,25</u>

You should end up with the following:
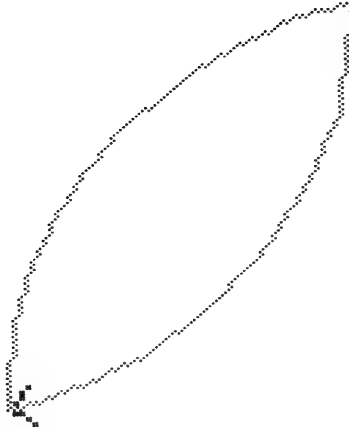
It is also possible to change an existing procedure to use stores. For example, you can change your SQUARE procedures so that the sides can be any chosen length, by typing this:

     <u>CHANGE SQUARE</u>
     <u>S</u>   to make SQUARE expect a number each time it is used.
     <u>SIDE</u> since we are going to call this number SIDE
     <u>D</u>   to move down
     <u>R</u>   to remove FORWARD 50
     <u>I</u>   to start inserting
     <u>FORWARD SIDE</u>

     | ESC | to stop inserting
     <u>E</u>   to end the changes

If you now type

     <u>FRESH</u>
     <u>SQUARE 30</u>
     <u>RIGHT 90</u>
     <u>FORWARD 10</u>
     <u>SQUARE 60</u>

You should end up with the following:
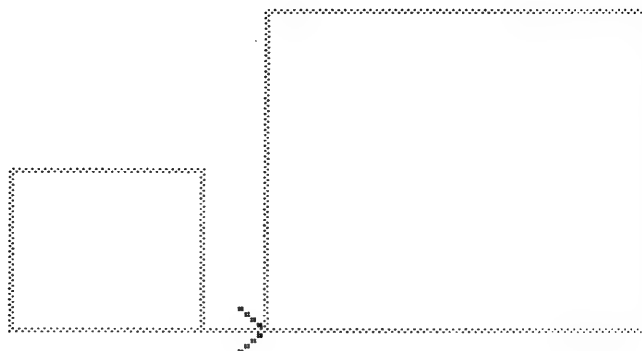
EXERCISES

10. Use the CHANGE command to change the instructions for the triangle
that you built in question 7 so that it expects to be given the
length of the side of the triangle.

11. Now change the HOUSE so that it expects to be given the length of
the side of the square and the triangle. Try drawing different size
houses on the screen.

12. Now build a new house, called HOME, which is made from a square of
side 80 and a triangle roof of side 80. Then draw four squares of
side 15 as windows inside the house. (You will need to move the pen
backward before you start, or your home will not fit on the screen.)

Doing arithmetic

It is possible to do simple arithmetic with the numbers in stores, using
the MAKE command. Two examples of how to use this command now follow.

The following will draw an oblong of any height, and whose length will be
30 units more than the height.

```
BUILD OBLONG WITH HEIGHT
MAKE LENGTH BECOME HEIGHT + 30
REPEAT 2
FORWARDS HEIGHT
RIGHT 90
FORWARD LENGTH
RIGHT 90
LIMIT
```

Press ⎡ ESC ⎤ to stop building

If you now type:

> FRESH
> OBLONG 40

you should end up with the following:
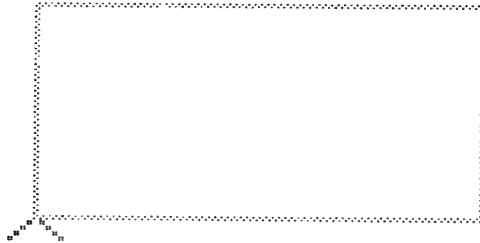
The program that follows shows another way of repeating something, using a command inside itself. This is called recursion.

> BUILD SPIRAL WITH SIDE
> FORWARD SIDE
> LEFT 90
> MAKE SIDE BECOME 5 MORE
> SPIRAL SIDE
> Press ⎣ ESC ⎦ to stop building

If you now type:

> FRESH
> SPIRAL 10

You should end up with something like the following - the actual number of sides will depend on the amount of memory in the computer.
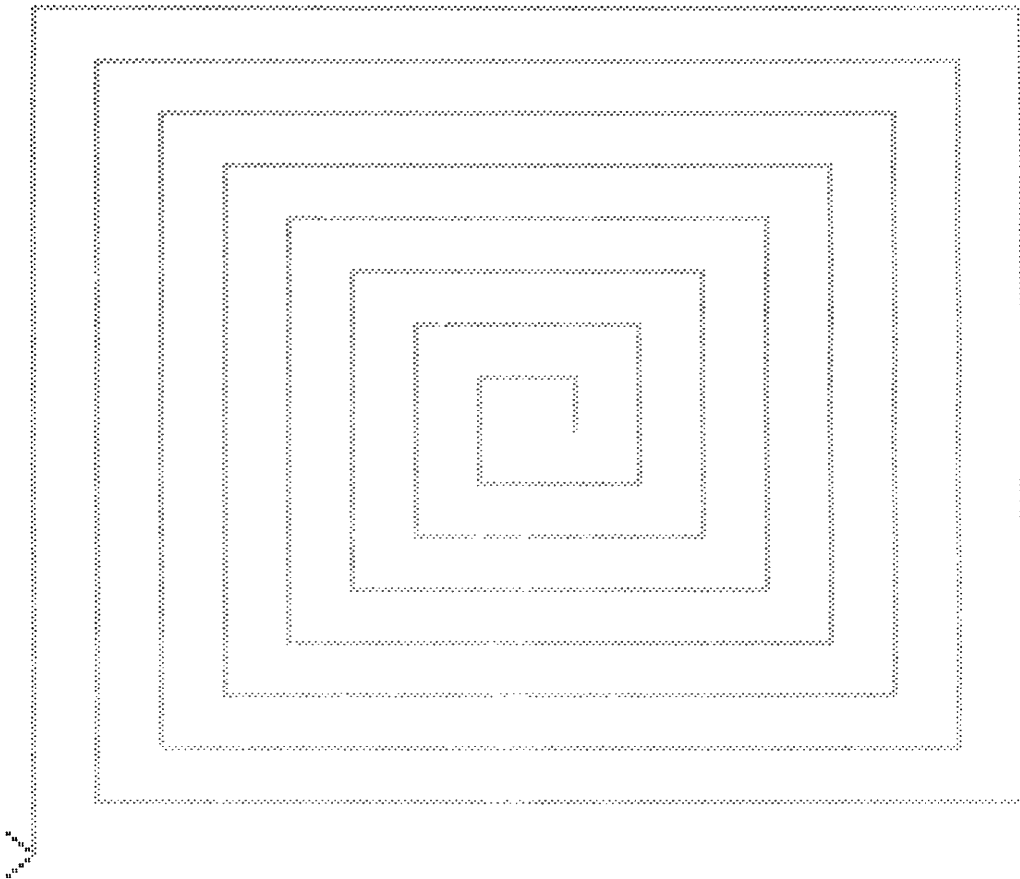
In fact, this would never end unless you did something to stop it. However, the computer will not be able to do it for ever, so it will eventually stop and say:

Sorry, I can't do this any more.

It is possible to avoid this problem by using the IF instruction. For example, to make sure that the spiral stopped just before the length of the side was 60, then type:

CHANGE SPIRAL
D to move down
D to move down
D to move down
R to remove SPIRAL SIDE
I to start inserting
IF SIDE < 60 THEN SPIRAL SIDE
press ESC to stop inserting
E to end the changes

15

If you now type:

> FRESH
> SPIRAL 10

You should end up with the following:
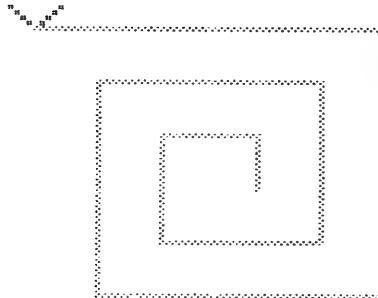
Finally, try this:

> BUILD PATTERN WITH XMOVE,YMOVE
> MAKE X BECOME 0
> MAKE Y BECOME 0
> REPEAT 200
> FORWARD YMOVE
> MAKE Y BECOME YMOVE MORE
> IF Y > 70 THEN MAKE YMOVE BECOME - YMOVE
> IF Y < -70 THEN MAKE YMOVE BECOME -YMOVE
> RIGHT 90
> FORWARD XMOVE
> MAKE X BECOME XMOVE MORE
> IF X > 120 THEN MAKE XMOVE BECOME -XMOVE
> IF X < -120 THEN MAKE XMOVE BECOME -XMOVE
> LEFT 90
> LIMIT
> Press ESC to stop building

If you now type:

> FRESH
> PATTERN 10,8

you should end up with the following:
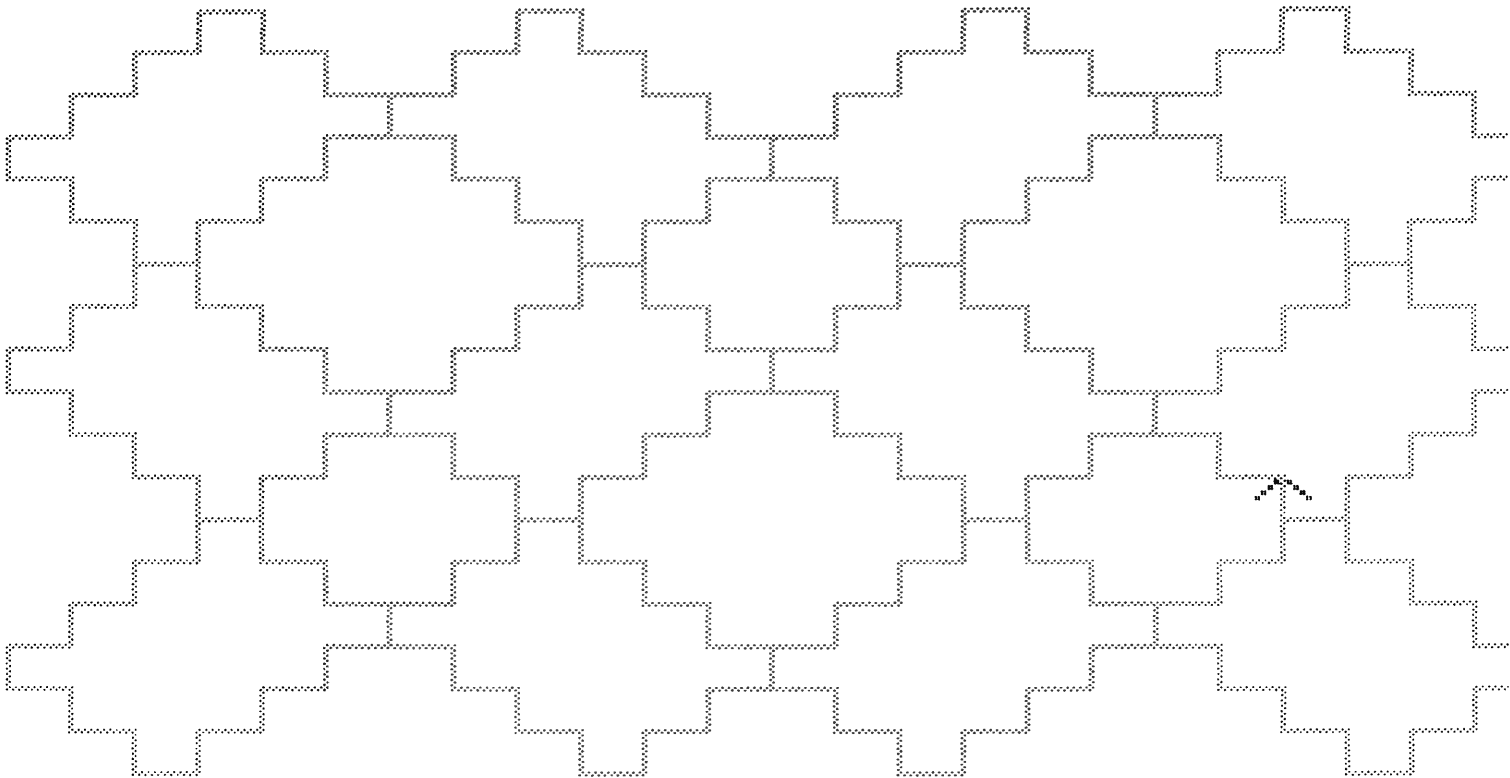
EXERCISES

13. Use the BUILD command to build a rectangle where the length is always twice the height. (Hint: to multiply, use *).

14. Change SPIRAL so that the length of the side is halved each time round. (Hint: to divide, use /).

15. Build a pattern made up of squares. Each square should be half as big again as the one before, and placed so that it evenly surrounds it. There should be no connecting line between any of the squares.

Saving what you do

If you want to save the procedures that you have built, then you can do so, either on cassette tape or on a disc if you have a suitable system. You can either save a particular procedure, or all the procedures. If you just type:

<u>SAVE</u>

then all you procedures will be saved together. On a disc system the procedures will be stored automatically on the disc you are using. On a cassette system you will be asked to put a tape into the cassette recorder, and then start it recording. Once it has started (allow a few seconds to make sure that you have passed the start of the tape), you should then press the [RETURN] key.

Put a tape into the cassette recorder.
Start recording
Press the [RETURN] key

You will be told when the recording is complete, and you can then stop the tape recorder, and remove the tape.

To get your procedures back, then type:

LOAD

On a disc system, the procedures will be automatically loaded from the disc you are using. On a cassette system you should put the cassette in the tape recorder, and press play. If your procedures are being loaded from cassette then you should see the following:

```
ALL.ARW          0000
ALL.ARW          0001          or          Reading ALL.ARW 0000
ALL.ARW          0002
```

(ALL.ARW is the name of the file containing all your procedures). When this has finished, you will be asked to wait while a list of all the procedures in the file is printed. When the colon prompt is given you will be able to use your procedures as before.

If you only want to save one procedure, then give the name of the procedure as part of the SAVE command. For example:

SAVE TRIANGLE
Filename shortened to TRIANG

You will notice that the name of the file can only have 6 letters at most. If your procedure has a longer name, then the filename will be shortened to the first six letters. When you load the file, then use the shortened filename:

LOAD TRIANG

```
TRIANG.ARW          0000          or          Reading TRIANG .ARW 0000
TRAING.ARW          0001
```

Once the file has been loaded you will still be able to use the full name TRIANGLE.

18

CHAPTER 2

SOME POSSIBLE FURTHER DIRECTIONS

This section contains some ideas for using ARROW. It should be clear by now
that these only scratch the surface - new ideas are coming up all the time.

Golf

Mark out a simple golf course on a piece of plastic film, and then stick
that on the televsion screen. It is a good idea to begin with a single
'hole' which you then have to give directions to get to, starting from the
centre. See if you can do it in one shot. You can then make the course
more complicated by putting in several holes, one after another, and some
bunkers which you have to go round. See how few shots you take to go round
the course.

A garden of flowers

You can use the procedure CURVE that you made in chapter 1 to build a
petal. If you then put six petals together, along with a stalk, you can
make a flower. You can then put several flowers together to make a garden.
Try to plan your garden so that the flowers which are further away appear
smaller.

Spirals

Try experimenting with different angles inside the spirals that you made in
chapter 1. Instead of an endless spiral, try a spiral section with a
chosen number of sides, a chosen angle and a chosen increase in the length
of the side. If you then repeat this spiral section endlessly, it will
sometimes go on for ever, and sometimes it will join back together and
start all over again. Try to work out the relationship between the angle,
the number of sides in the section and the amount the sides are increased
by, so that repeating the spiral sections eventually join them up.

Hexagons

See if you can fill the whole screen with hexagons. Start by drawing a
single hexagon, then a line of hexagons, and finally enough lines to fill
the screen. To start with you should use a fixed size hexagon. When you
have done that, try to make it work with the user able to choose the size
of the hexagon. Try to experiment with other ways of filling the screen
with hexagons - perhaps by drawing a spiral of hexagons?

Letters and making words

In Exercise 1 of Chapter 1 you gave the instructions to draw some simple letters. Now try to build some more letter shapes. Make sure that they always start and end at the same place in relation to the letter. Now try to build a word from your letters.

Tesselations

Draw a shape which tesselates - for example, a triangle, a diamond, a parallelogram, or a more irregular shape. (A shape that tesselates is one which will fill the screen without leaving any gaps - like the hexagon). Then try to fill the screen in the same way as with the hexagons.

INFORMATION ABOUT EACH COMMAND

There are three types of instructions which can be given to the computer when the colon prompt (:) appears at the bottom left hand corner of the screen. The first type of instructions are called primitives and these do the actual screen drawing, etc.. Examples of primitives are FORWARD and REPEAT. The second type are called commands and do not affect the screen drawing directly. Examples of commands are HELP and CHANGE. The third type of instructions are called procedures and these only exist if you define them using the BUILD command, or if you load them from disc or cassette. An example of a procedure is SQUARE which was defined in Chapter 1. You can use primitives or other procedures inside a procedure, but you cannot use commands.

PRIMITIVES

BACKWARD   This moves the pen backward, in the opposite direction to the arrow. It must always be given with a number or a store name, which is the amount which is to be moved. The screen is approximately 300 units wide and 200 units high.

For example: BACKWARD 30
                    BACKWARD LENGTH

CENTRE   This moves the pen to the centre of the screen, without drawing and without changing the screen.

CLEAN   This cleans the screen, but leaves the pen in the same position as it was.

END   This instruction cannot be used on its own. It is assumed to be at the end of every procedure, but you should not type it in yourself. The END instruction can only be used as part of an IF instruction.

For example: IF SIDE > 25 THEN END

FORWARD   This moves the pen forward, in the direction of the arrow. It must always be given with a number or a store name, which is the amount which is to be moved. The screen is approximately 300 units wide and 200 units high.

For example: FORWARD 20
                    FORWARD SIDE

FRESH   This cleans the screen and moves the pen back to the centre of
             the screen. It is the same as the CLEAN and CENTRE
             instructions combined.

IF   This allows you to make a choice of action. You can compare
             the value in a store with a number, or with the value in
             another store, using the following:

                 =   equal
                 <   less than
                 >   greater than
                 <=   less than or equal to
                 >=   greater than or equal to
                 <>   not equal

             If the comparison is true, then the computer can do any
             primitive except REPEAT, LIMIT or another IF, or any procedure.
             It is also possible for the computer to do any primitive
             (except REPEAT, LIMIT or IF) or any procedure if the comparison
             is not true.

             For example: IF SIDE < 25 THEN FORWARD SIDE
                             IF LENGTH = 0 THEN END ELSE SPIRAL
                             IF BIT <> 0 THEN LEFT BIT ELSE CENTRE
                             IF SIDE > LENGTH THEN SQUARE 50

LEFT   This changes the direction that the arrow points. It must
             always be given with a number or a store name, which is the
             amount that the arrow is to be turned left. The number is the
             amount the arrow turns, in degrees. Remember that a quarter
             turn is 90 degrees.

             For example: LEFT 45
                             LEFT ANGLE

LIMIT   This instruction is only used after a REPEAT instruction. All
             the instructions between the REPEAT and the LIMIT will be
             repeated the number of times given in the REPEAT instruction.

MAKE   This instruction is used to change the value of a store. It
             alway starts with the name of the store whose value is to be
             changed. The next word must be BECOME. Following that must be
             one of these simple expressions:

                 A number
                 Another store
                 Another store with a minus sign in front
                 A number or a store followed by either MORE or LESS
                 A number or a store followed by an operation and then
                     another number or store. The operations can be
                     +   to add, - to subtract,
                     *   to multiply and / to divide.

22

Note that any store mentioned after the BECOME must already have been given a value.

For example: MAKE SIDE BECOME 30
                MAKE ANGLE BECOME 360 / NUMBER
                MAKE LENGTH BECOME BIT LESS
                MAKE WIDTH BECOME HEIGHT * 2

PEN   This instruction must be followed by either the word ON or the word OFF. The PEN OFF instruction means that if the arrow is moved, no trace is left. Hence the normal FORWARD, BACKWARD, LEFT and RIGHT commands can be used to move the pen to any position without drawing a line. The PEN ON instruction means that from then on, moving the arrow will leave a trace as normal.

REPEAT   This instruction is used to repeat a set of instructions. It must be followed by a number or a store name, and the instructions after the REPEAT will be repeated this number of times. The LIMIT instruction is used to show the end of the list of instructions which are to be repeated.

For example: REPEAT 4   REPEAT COUNT
                        .   .
                        .   .
                        .   .
                    LIMIT   .
                                                LIMIT

RIGHT   This changes the direction that the arrow points. It must always be given with a number or a store name, which is the amount that the arrow is to be turned right. The number is the amount the arrow turns, in degrees. Remember that a quarter turn is 90 degrees.

For example: RIGHT 90
                    RIGHT TURN

SCALE   Allows you to change the scale of the units on the screen. It is followed by either one or two numbers or stores. If there is one number then this applies to both the horizontal and vertical directions. If there are two numbers then the first number will affect the horizontal direction and the second will affect the vertical direction. If you want to return the scale in both directions to normal then give the instruction SCALE 1. Warning: if you give a scale of zero then you will stop all movement in that direction.

For example: SCALE 3
                    SCALE HEIGHT, WIDTH

BUILD

This allows you to build a new procedure. The BUILD command should be followed by the name of the procedure. If you want to us one or more values each time you use the procedure, the next word should be WITH, followed by the names of the stores for the values you will type in each time you use the procedure. There is a maximum of 4 stores allowed with any procedure.

Once you have typed the BUILD instruction, the screen will change so that you can type in the procedure. You can use any mixture of primitives and procedures, including the procedure itself (this is called recursion), and procedures that you have not yet built. Obviously, you will have to then build those procedures before you actually use this one.

When you have finished typing in your procedure you should press ⌷ ESC ⌷ to end.

For example: BUILD SHAPE
                       BUILD SQUARE WITH SIDE
                       BUILD SPIRAL WITH NUMBER, ANGLE, BIT

CHANGE

This allows you to change a procedure that you have already built. It should be followed with the name of the procedure that you want to change. You must not include any store names which are used with the procedure.

The screen will change so that you can see the first 12 lines of your procedure. A flashing white dot will show which line you are about to change. You can use the U and D keys to move the flashing white dot up or down, to get to the place that you want to change. Once you have got to the correct place, then you can remove that line by pressing R. You can insert one or more lines (just in front of the line the white dot is pointing to), by pressing I. In that case you will be able to type in extra lines in the same way as when you build a procedure. When you have finished inserting at this point then press the ESC key, which will take you back to changing. You can then move the flashing dot to somewhere else.

If you want to change the stores which are used with the procedure, then press S. You will then be able to type in the names of stores that you want to use. If you just press RETURN without typing in a store name then when you use the procedure it will not expect any values at all.

When you have made all the changes that you want, press E to stop changing and go back to the colon prompt.

For example: CHANGE SPIRAL

COMMANDS   This give a list of all the commands and primitives.

DELETE   This allows you to delete a procedure from the computer's
              memory. It should be followed by the name of the procedure that
              you want to delete. Once it has gone, the procedure cannot be
              recovered - you would have to type it in again. Deleting a
              procedure will not affect anything that you have already stored
              on tape or disc.

              For example: DELETE SQUARE

DIR   For disc use ONLY.
              This gives a list of the procedures on the disc that you are
              using. The name of the file with all the procedures in will be
              called ALL.ARW.

FAST   This switches the drawing speed during procedures and REPEATs
              to be fast. The information about which instruction is being
              obeyed is not printed.

FINISH   This ends the program, and returns you to BASIC. If you want
              to use the program again, then type RUN.

HELP   This gives a brief message to remind you of what a particular
              command or primitive does. It should be followed by the name
              of the command or primitive that you want information about.
              If you want help with all the commands and primitives then you
              should type HELP ALL.

              For example: HELP MAKE
                             HELP TURTLE
                             HELP ALL

LIST   This gives a list of all the current procedures. (IT does not
              include anything that you might have stored on tape or disc).
              If the command is followed by the name of a procedure then the
              actual procedure is listed.

              For example: LIST
                             LIST SPIRAL

LOAD   This allows you to load procedures that have already SAVEd on
              tape or disc. If the command is followed by the name of a
              file, then the computer will look for the file containing that
              procedure. Filenames are always abbreviated to the first 6
              letters.

              On a disc system the file will be loaded automatically.

              On a cassette system, you must put the tape containing the file
              in the cassette recorder and then press play. You will be told
              when the tape has loaded, and you can then switch off the
              cassette recorder.

For example: LOAD
              LOAD SQUARE

PLIST   This prints a list of all the current procedures, on the
           printer. You should only use it if you have a printer
           connected. The printer option is set automatically by the
           program. However, your printer may use a different option to
           that expected by the program, and you should change it
           accordingly. See technical notes on page 30 for details of how
           to do this. If the command is followed by the name of a
           procedure then the actual procedure is printed.

For example: PLIST
              PLIST OBLONG

RESTART   This command has the same effect as finishing the program and
           then running it again. It completely clears all your
           procedures and stores from the memory.

SAVE   This allows you to save procedures on tape or disc. If the
           command is given on its own, the computer will save all your
           procedures, in a file called ALL.ARW. If the command is
           followed by the name of a procedure, then the computer will
           just save that procedure in a file of that name, along with any
           other procedures that are mentioned in that procedure. If you
           want to save several procedures then you should give them in a
           list, after the command, separated by commas. In that case the
           file will be given the name of the first procedure in the list.
           Filenames are always abbreviated to the first 6 letters.

           On a disc system the file will be saved automatically.

           On a cassette system, you must put a blank tape in the cassette
           recorder and then start recording. Wait a few seconds for the
           tape to get past the start, and then press the RETURN key. You
           will be told when the procedures have been saved, and you can
           then switch off the cassette recorder.

For example: SAVE
              SAVE HOUSE
              SAVE TRIANGLE, SPIRAL, CURVE

SLOW   This switches the drawing speed to SLOW. The information about
           which instruction is being obeyed will be printed each time,
           and there is a pause of at least a second between each
           instruction.

TURTLE   This allows you to connect a turtle. You should only use this
           command if you have a turtle connected. To start the turtle,
           then give the TURTLE ON command. To stop the turtle, give the
           TURTLE OFF command. While the turtle is any movement command
           (FORWARD, BACKWARD, LEFT and RIGHT) will appear on the screen
           as usual, and also be obeyed by the turtle. The turtle will
           also obey the PEN command. Please note that the turtle does

<u>not</u> obey the FRESH, CLEAN or CENTRE commands, and is <u>not</u> affected by the SCALE command.

VALUES   This gives a list of the stores that have been mentioned so far, and their current value. Note that if a store has not yet been given a value, its value will be blank, not zero.

CHAPTER 4

TECHNICAL NOTES

You are allowed to abbreviate any command, primitive or procedure to the first three or more letters. If you then want to follow the command with numbers or store names, then leave a space and continue as usual.

        For example,   FOR 30   instead of   FORWARD 30
                        REC 10,50   instead of   RECTANGLE 10,50
                        BAC LENGTH   instead of   BACKWARD LENGTH
                        VAL   instead of   VALUES

Please note that you are not allowed to abbreviate the names of stores. The store called LEN is quite different to the store called LENGTH.

Procedure names - Limitations

You are not allowed to use more than 12 letters for the name of a procedure. The name must only contain letters - you cannot use numbers, punctuation or spaces.

ARROW will not allow you to use certain names for procedures. If the computer tells you that a certain name is not allowed when you try to build a procedure, then don't worry - just choose a different name.

You are not allowed to use the name ALL for a procedure. The most common reason for not allowing a name is that it clashes with the first three letters of another command, primitive or procedure.

        For example: You cannot use the name LIMPET
                        because it clashes with the primitive LIMIT

                        You cannot use the name TURN
                        because it clashes with the command TURTLE

                        You cannot use the name PENTAGON
                        because it clashes with the primitive PEN

You may have noticed that if you mention a procedure before you have built it, then you are normally given the message "Warning: I don't understand NAME yet". However, if that name is not allowed for a procedure then you will be told that the computer doesn't understand what you have just said.

Store names - limitations

You are not allowed to use more than 12 letters for the name of a store. The name must only contain letters - you cannot use numbers, punctuation or spaces.

The computer will not allow you to use the word ELSE as a store name.

Changing speed when drawing

The FAST and SLOW commands set what the drawing speed will be when you the computer is obeying a procedure or a REPEAT. However, you may want to change the speed once the procedure or REPEAT has started. To do this, press the F key to make the drawing fast, or the S key to make the drawing slow. You can do this as many times as you like while the computer is actually doing the drawing. Once you get the colon prompt, then you must give the command in full.

Stop drawing

You can stop any drawing at any time by pressing the colon (:) key. To help you remember, think about pressing the colon key to get back to the colon prompt. Once you have stopped the drawing, it is not possible to continue the procedure from where you left off - you will have to start again.

Mentioning procedures before you build them

When you are building or changing a procedure, you are allowed to mention other procedures before you build them. IF you do, then you will have to build these before you use any procedure in which you mention them.

There is a possible confusion about the names of these procedures, because of abbreviations. When you mention the procedure before you build it, you are allowed to use abbreviations. So, if you intend to build HOUSE later on, you can still call it HOU when you first mention it, and this will be changed when you build HOUSE itself. However, the name that you build is taken to be the correct name, and cannot be an abbreviation. So, if you refer to HOUSEBOAT before you build HOUSE, the computer will not then call that procedure HOUSEBOAT. Also, you will not be able to build a procedure called HOUSEBOAT once you have built one called HOUSE. The only solution will be to change any reference to HOUSEBOAT to something else

Printers

If you use the PLIST command you will need to have a printer connected and it is necessary also to tell the computer what type of printer you have. ARROW assumes that you have a particular type of printer and tells the comupter. This is printer type 4, at speed 6 - ie, PRINTER 4,6. If you have a different printer, you will have to change your version of ARROW. (It is no use telling the computer yourself what type of printer you have because ARROW will tell the computer about its printer after you do.) To change the printer, you will need to change line 2 of the program as follows. This example supposes that you have printer type 3.

Load the program as usual. Do NOT type RUN.

Type   2 PRINTER 3

            On a 480Z you will need to put a blank tape into the
            cassette recorder, and start recording.

            SAVE "ARROW"

Connecting a TURTLE

If you have a turtle, then it is normally connected to the SIO-4 socket,
and runs at 1200 baud (speed code 3). If this is not the case, then you
can change ARROW in a similar way to changing the printer speed (see
above). The only difference is that you will have to change line 4 of the
program, as follows - suppose that the turtle is to be connected to the
SIO-2 at 300 baud (speed code 1)

            Load the program as usual. Do NOT type RUN.

            Type   4 PRINTER 2, 1

                        On a 480Z you will need to put a blank tape into the
                        cassette recorder, and start recording.

                        SAVE "ARROW"

If at any stage the turtle does not appear to be connected to the computer,
then if the TURTLE has been switched on and a movement instruction is
given, a warning message will be given and the turtle will be switched off.
Please note that the computer will take about 20 seconds to decide that the
turtle is not properly connected.

Arrow and function keys   LINK 480Z only

The small keypad at the right of the 480Z can be used for some of the
instructions, instead of typing them in. If you press any of the four
arrow keys, then one of the words FORWARD, BACKWARD, LEFT and RIGHT are
typed in for you. You will still have to type in how far you want to go.
The key F1 will give the FRESH command; the key F3 will give the REPEAT
instruction (you will have to type in how many times you want to repeat),
and the F4 key will give the LIMIT instruction.

A cut out reminder of what each of these keys do is printed at the back of
this booklet; you might like to cut it out, stick it on a piece of card,
and fit it over the keypad.

Errors

If you make a mistake you will usually be given a helpful message. Once
the computer has told you of your mistake, it will then ignore what you

have just done, and allow you to try again.

<u>Do not be afraid to make mistakes - it is a good way to learn</u>

Sometimes the message from the computer may not make sense - this happens
because the computer hasn't understood you, and has tried to guess what you
mean - sometimes it will guess wrong. It may be helpful to realise that
the computer starts at the beginning of a command and if it is correct
works through the command until it meets something wrong. It then assumes
that it is this which is wrong, even if most of the rest of the command
obviously meant something else.

> For example   if you type MAKE SQUARE WITH SIDE
>   you probably meant to say BUILD instead of MAKE.
>
>   However, the computer will assume that MAKE
>   is correct, and that you want to change a store
>   called SQUARE. It will then expect to find the word
>   BECOME and will give the message:
>   Should say BECOME, not WITH

If the computer's message isn't helpful, then just think about what you
should have said and then type that instead - don't worry too much about
what the computer thought you were trying to say.

Some of the messages need a little more explanantion:

<u>Sorry, there's no room left</u>

This can happen for several reasons. You may have too many procedures; you
may have too many instructions inside your procedures; you may have too
many variables. If it is either of the first two reasons, then you will
find that you cannot give any primitive or procedure as an instruction.
One solution may be to DELETE a procedure that you no longer need.
Otherwise, you can SAVE some of the procedures, (don't SAVE them all at
once or you will have the same problem when you LOAD them again.) You can
then clear the memory with the RESTART command, and LOAD those procedures
that you want.

<u>Sorry, I can't do this any more</u>

This happens if you use recursion that doesn't end, or if you use REPEAT
inside REPEAT a lot of times. The computer will stop drawing and return to
the colon prompt. It is caused by the computer running out of room and
there is no way of overcoming the problem, except to not ask the computer
to do quite as much.

ANSWERS

Please note that these are not the only possible answers, or even the best anwer. They are simply to give you an idea if you are stuck. It should be possible to type these answers in directly. In the case of a procedure there is usually an example of how to use it.

1.   FRESH
            LEFT 90
            FORWARD 30
            RIGHT 90
            FORWARD 40
            RIGHT 90
            FORWARD 30

            FRESH
            FORWARD 40
            LEFT 90
            FORWARD 15
            BACKWARD 30

            FRESH
            FORWARD 20
            RIGHT 90
            FORWARD 15
            BACKWARD 15
            LEFT 90
            FORWARD 20
            RIGHT 90
            FORWARD 30

            FRESH
            FORWARD 40
            LEFT 90
            FORWARD 40
            LEFT 90
            FORWARD 40
            LEFT 90
            FORWARD 40

            FRESH
            FORWARD 40
            RIGHT 90
            FORWARD 40
            RIGHT 135
            FORWARD 57

```
2.          FRESH
            FORWARD 50
            RIGHT 120
            FORWARD 50
            RIGHT 120
            FORWARD 50


3.          FRESH
            FORWARD 50
            LEFT 120
            FORWARD 30
            RIGHT L50
            FORWARD 62
            RIGHT 120
            FORWARD 62
            RIGHT 150
            FORWARD 30
            LEFT 120
            FORWARD 50
            RIGHT 90
            FORWARD 10


4.          FRESH
            REPEAT 3
            FORWARD 50
            RIGHT 120
            LIMIT


5.          FRESH
            REPEAT 2
            FORWARD 40
            RIGHT 90
            FORWARD 70
            RIGHT 90
            LIMIT


6.          FRESH
            PEN OFF
            LEFT 90
            FORWARD 100
            RIGHT 90
            PEN ON

            REPEAT 5
            FORWARD 40
            LEFT 90
            FORWARD L5
            BACKWARD 30
            PEN OFF
            LEFT 90
```

```
                    FORWARD 40
                    LEFT 90
                    FORWARD30
                    LEFT 90
                    PEN OFF
                    LIMIT


7.                  BUILD TRIANGLE
                    REPEAT 3
                    FORWARD 50
                    LEFT 120
                    LIMIT
                    Press ESC to stop building

                    FRESH
                    TRIANGLE


8.                  BUILD SHAPE
                    FORWARD 20
                    RIGHT 90
                    FORWARD 15
                    BACKWARD 15
                    LEFT 90
                    FORWARD 20
                    RIGHT 90
                    FORWARD 30
                    Press ESC to stop building

                    FRESH
                    SHAPE


9.                  BUILD ROW
                    REPEAT5
                    SHAPE
                    PEN OFF
                    RIGHT 90
                    FORWARD 40
                    LEFT 90
                    FORWARD 20
                    LEFT 90
                    PEN ON
                    LIMIT
                    Press ESC to stop building

                    FRESH
                    PEN OFF
                    LEFT 90
                    FORWARD 100
                    RIGHT 90
                    PEN ON
                    ROW
```

```
10.        CHANGE TRIANGLE
           S
           SIDE
           D
           R
           I
           FORWARD SIDE
           Press ESC to stop inserting
           E

           FRESH
           TRIANGLE 40


11.        CHANGE HOUSE
           S
           SIDE
           R
           R
           I
           SQUARE SIDE
           FORWARD SIDE
           Press ESC to stop inserting
           D
           R
           I
           TRIANGLE SIDE
           Press ESC to stop inserting
           E

           FRESH
           HOUSE 30


12.        BUILD HOME
           SQUARE 80
           FORWARD 80
           LEFT 30
           TRIANGLE 80
           LEFT 150
           FORWARD 15
           RIGHT 90
           PEN OFF
           FORWARD 15
           PEN ON
           REPEAT 4
           SQUARE 15
           PEN OFF
           FORWARD 50
           LEFT 90
           PEN ON
           LIMIT
           Press ESC to stop building
```

```
        FRESH
        PEN OFF
        BACK 60
        PEN ON
        HOME


13.     BUILD RECTANGLE WITH HEIGHT
        MAKE LENGTH BEOME HEIGHT * 2
        REPREAT 2
        FORWARD HEIGHT
        RIGHT 90
        FORWARD LENGTH
        RIGHT 90
        LIMIT
        Press ESC to stop building

        FRESH
        RECTANGLE 40


14.     CHANGE SPIRAL
        D
        D
        R
        I
        MAKE SIDE BECOME SIDE/2
        Press ESC to stop inserting
        R
        I
        SPIRAL SIDE
        Press ESC to stop inserting
        E

        FRESH
        SPIRAL 80


15.     BUILD EXPAND WITH SIDE
        MAKE MOVE BECOME SIDE/4
        SQUARE SIDE
        PEN OFF
        RIGHT 90
        FORWARD MOVE
        LEFT 90
        BACKWARD MOVE
        PEN ON
        MAKE SIDE BECOME SIDE * 1.5
        EXPAND SIDE
        Press ESC to stop building

        FRESH
        EXPAND 8
```

INDEX